BORROW SOURCE CHARACTERIZATION STUDY

for the

RANKIN MILL ROAD PARCELS

of the

WHITE STREET LANDFILL
GREENSBORO, NORTH CAROLINA

Prepared for:
City of Greensboro, North Carolina

GREENSBORO®

Prepared by:
HDR Engineering, Inc. of the Carolinas

HDR

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1.0 PROJECT DESCRIPTION

The purpose of this report is to characterize 40 acres of the White Street Landfill located adjacent to Rankin Mill Road to determine the quantity and quality of soils and their potential use as structural fill, soil liner, closure soils (infiltration and erosion layers), and daily and intermediate cover. The following sections describe each phase of the Borrow Source Characterization Study (BSCS).

2.0 FIELD SAMPLING/SUBSURFACE INVESTIGATION

The field sampling and subsurface investigation portion of the work consisted of the excavation of three test pits and the drilling of eight 6-inch diameter borings.

The test pits were excavated so that bulk samples of each predominant soil type could be obtained for the determination of Laboratory Compaction Characteristics (Standard Proctor) and Hydraulic Conductivity. Additionally, the excavations were used to aid in the delineation of the available soil types within the potential borrow area.

The purpose of the borings and subsequent laboratory testing program was to obtain additional geotechnical data to provide a better definition of the subsurface conditions and soil types over a broader area within the potential borrow area.

Piezometers were installed in three of the borings. Water levels are to be monitored periodically to establish vertical excavation limits. Prior to use as a borrow area, an Erosion and Sediment Control Plan must be approved. The excavation limits would be provided under separate cover as part of the Erosion and Sedimentation Control Plan.

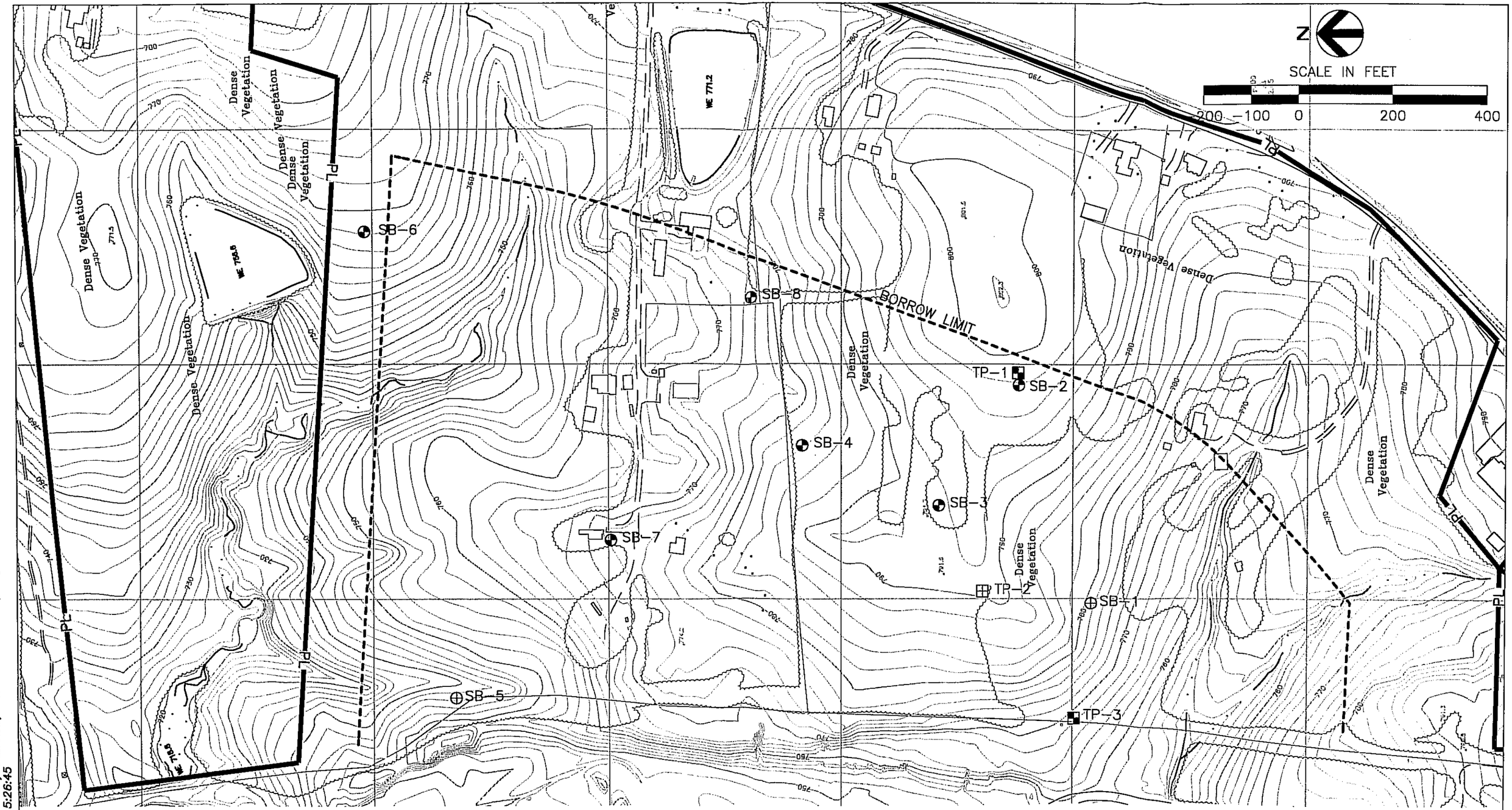
Logs of the test pit excavations and the driller's field logs are included in Appendix A. Plan locations of the tests pits and borings are presented on Figure 1.

3.0 LABORATORY TESTING

Laboratory testing consisted of:

- Moisture Contents
- Sieve Analyses
- Atterberg limits
- USCS Classification
- Laboratory Compaction Relationships (Standard Proctor)
- Recompacted Hydraulic Conductivity

Summaries of the laboratory testing programs for the bulk samples and jar samples obtained from the borings are presented in Tables 1 and 2, respectively. Appendix B contains the laboratory test data performed for the BSCS.



LEGEND

- SOIL BORING SURVEYED
- TEST PIT SURVEYED
- SOIL BORING APPROXIMATE
- SOIL BORING SURVEYED

NOTES

1. PROPERTY AND BUFFER LIMIT LINES PROVIDED BY THE CITY OF GREENSBORO.
2. TOPOGRAPHY FROM JANUARY 30, 2002 AERIAL PHOTOGRAPHY.

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Rankin Mill Road
Proposed Borrow Area

Borrow Source Characterization Study

Date 6/2002

Sheet 1

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TABLE 1
TEST PITS
SUMMARY OF SOILS LABORATORY TESTING

TEST PIT	LOCATION DEPTH (FT)	DESCRIPTION	LIMITS			INSITU	PROCTOR DATA		% Passing the 200 Sieve	Hydraulic Conductivity K (cm/sec)
			LL	PL	PI	Water Content	DENSITY (pcf)	Water Content		
1	1.3-2.3	Red/Brown silty CLAY, some sand (CH)	52	22	30	27.0%	98.0	23.4%	70	1.10E-08
	3.4-4.4	Red/Brown silty CLAY, some sand (CH)	69	32	37	32.8%	86.1	32.3%	82	1.80E-06
	10-12.5	Red/Brown SILT, some sand (MH)	51	36	15	31.4%	87.7	28.1%	72	1.50E-05
	13-15	Tan silty SAND (SM)	NP	NP	NP	18.8%	97.8	22.2%	31	1.60E-05
2	1.0-2.0	Red/Brown silty CLAY, some sand (CH)	66	32	34	35.2%	88.9	28.0%	78	2.10E-06
	3.0-5.0	Red/Brown SILT, some sand (MH)	53	34	19	34.4%	90.2	27.5%	73	3.00E-06
	14-14.5	Red/Brown SILT, some sand (MH)	72	44	28	47.3%	80.5	36.0%	76	2.30E-06
3	3.0-4.0	Tan/Brown SAND, some clay (CL)	47	27	20	28.8%	96.5	22.9%	73	9.70E-08
	13.0-14.0	Tan/Brown silty SAND (SM)	NP	NP	NP	27.1%	104.5	18.0%	36	1.10E-05

TABLE 2
BORINGS
SUMMARY OF SOILS LABORATORY TESTING

BORING	SAMPLE	DEPTH (FT.)	DESCRIPTION	Atterburg Limits		In situ Water Content	% Passing the 200 Sieve
				Liquid Limit LL	Plastic Index PI		
SB-1	1	2.5-4.0	Brown micacious silty SAND (SM)		NP	10.8%	45
	2	5.0-6.5	Brown micacious silty SAND (SM)		NP	11.8%	48
	3	7.5-9.0	Brown micacious silty SAND (SM)		NP	15.6%	41
	4	10.0-11.5	Brown micacious silty SAND (SM)		NP	15.3%	43
	5	15.0-16.5	Brown micacious silty SAND (SM)		NP	16.9%	42
	6	20.0-21.5	Brown micacious silty SAND (SM)		NP	16.4%	43
	7	25.0-26.5	Brown micacious silty SAND (SM)		NP	15.5%	44
SB-2	1	15.0-16.5	Red/Brown micacious Silt, some sand (ML)		NP	28.9%	71
	2	20.0-21.5	Red/Brown micacious sandy SILT (ML)		NP	42.0%	65
	3	25.0-26.5	Red/Brown micacious sandy SILT (ML)		NP	29.5%	52
	4	30.0-31.5	Red/Brown micacious sandy SILT (ML)		NP	43.9%	53
	5	35.0-36.5	Brown micacious SAND and SILT (ML)		NP	36.0%	50
	6	40.0-41.5	Brown micacious silty SAND (SM)		NP	25.1%	41
	7	45.0-46.5	Brown micacious sandy SILT (ML)		NP	29.4%	67
SB-3	1	2.5-4.0	Red/Brown micacious SILT (MH)	81	39	32.1%	92
	2	5.0-6.5	Red/Brown micacious sandy SILT (MH)	64	27	31.8%	70
	3	7.5-9.0	Red/Brown micacious SILT, some sand (MH)	72	28	39.5%	81
	4	10.0-11.5	Red/Brown micacious SILT (MH)	70	23	45.0%	99
	5	15.0-16.5	Red/Brown micacious sandy SILT (ML)		NP	24.5%	57
	6	20.0-21.5	Red/Brown micacious SILT (ML)		NP	66.6%	98
	7	25.0-26.5	Grayish tan SILT and SAND (SM)		NP	26.1%	50
	8	30.0-31.5	Grayish tan silty SAND (SM)		NP	29.7%	36
	9	35.0-36.5	Grayish tan SAND, some silt (SM)		NP	14.6%	29
	10	40.0-41.5	Grayish tan SILT, trace sand (MH)	51	19	35.3%	90

TABLE 2
BORINGS
SUMMARY OF SOILS LABORATORY TESTING

BORING	SAMPLE	DEPTH (FT.)	DESCRIPTION	Atterburg Limits		In situ Water Content	% Passing the 200 Sieve
				Liquid Limit LL	Plastic Index PI		
SB-4	1	2.5-4.0	Red/Brown micacious SILT, some sand (MH)	60	19	30.3%	73
	2	5.0-6.5	Red/Brown micacious SILT, some sand (MH)	54	22	34.6%	82
	3	7.5-9.0	Red/Brown micacious sandy SILT (ML)		NP	29.8%	66
	4	10.0-11.5	Red/Brown micacious SILT, some sand (ML)		NP	28.6%	78
	5	15.0-16.5	Red/Brown micacious SILT, some sand (ML)		NP	37.2%	73
	6	20.0-21.5	Tan/Brown micacious SILT and SAND (SM)		NP	44.9%	50
	7	25.0-26.5	Tan/Brown micacious silty SAND (SM)		NP	36.4%	35
	8	30.0-31.5	Tan/Brown micacious SILT, some sand (ML)	48	7	41.8%	74
	9	35.0-36.5	Tan/Brown micacious silty SAND (SM)		NP	16.5%	41
	10	40.0-41.5	Tan/Brown micacious SAND, some silt (SM)		NP	15.8%	22
SB-5	1	2.5-4.0	Tan/Brown micacious SAND, some silt (SM)		NP	13.0%	24
	2	5.0-6.5	Tan/Brown micacious SAND, some silt (SC-SM)	28	6	9.6%	25
	3	7.5-9.0	Tan/Brown micacious SAND, some silt (SC-SM)	29	7	8.8%	16
SB-6	1	2.5-4.0	Green SILT, some sand (ML)		NP	26.3%	81
	2	5.0-6.5	Green SILT, some sand (ML)		NP	26.6%	81
	3	7.5-9.0	Green SILT, some sand (ML)	47	15	29.6%	77
	4	10.0-11.5	Green sandy SILT (ML)	36	6	22.3%	68
	5	15.0-16.5	Green sandy SILT (ML)	37	6	16.4%	65
SB-7	1	2.5-4.0	Tan/Brown micacious SILT, some sand (ML)	40	14	17.3%	70
	2	5.0-6.5	Tan/Brown micacious SILT, some sand (SM)		NP	9.7%	32
	3	7.5-9.0	Tan/Brown micacious silty SAND (SM)	29	4	14.2%	35
	4	10.0-11.5	Tan/Brown micacious clayey SAND (SC)	33	11	12.8%	29
	5	15.0-16.5	Tan/Brown micacious silty SAND (SM)		NP	18.5%	37
SB-8	1	2.5-4.0	Tan/Gray sandy CLAY (CL)	42	23	19.6%	58
	2	5.0-6.5	Tan/Brown micacious sandy CLAY (CL)	32	13	14.2%	65
	3	7.5-9.0	Tan/Brown micacious silty SAND (SM)	26	4	12.4%	33
	4	10.0-11.5	Tan/Brown micacious SAND some silt (SM)	25	3	11.0%	25

3.1 Soil Description and USCS Classification

Based on the results of the sieve analyses and Atterberg limits, the Unified Soil Classification System (USCS) classifications of the three predominant soil types are; red to brown cohesionless silty sand (SM) to sandy silt mixtures (ML), red to brown sandy silt (MH) and silty clay (CH) mixtures of relatively high plasticity, and tan/brown, and occasionally gray, very severely to severely weathered granite (SM). The weathered granite, locally known as "sand rock", classifies as SM because it has weathered to a silty sand size.

3.2 Laboratory Compaction Characteristics

Laboratory Compaction Characteristics (ASTM D698, Standard Proctor) were performed on each of the soils chosen for hydraulic conductivity testing. Standard Proctor data indicates that the maximum dry densities range from approximately 86 to 105 pounds per cubic foot (pcf). Optimum moisture contents range from approximately 18 to 36 percent and are, in most cases, slightly dryer than the measured natural moisture contents.

3.3 Grain Size Analyses and Atterberg Limits

Grain size analyses were performed and Atterberg limits were attempted on each of the 60 samples collected.

Each of the predominant soil types has a broad range of grain sizes. The sieve analyses for the cohesionless silty sand (SM) to sandy silt soils (ML) indicate a percent passing the No. 200 sieve ranging from 22 to 98. The soils having relatively high plasticity (MH and CH) have minus 200 sieve fractions ranging from 70 to 92. Grain size analyses performed on the weathered granite indicate a percent passing the No. 200 sieve ranging from 16 to 74.

The soils that are classified as ML or SM and the weathered granite are generally cohesionless. However, several of the samples did exhibit some cohesion with plasticity indices (PI) ranging from 3 to 14. The soils that were classified as MH or CH have liquid limits (LL) ranging from 51 to 81 and plasticity indices ranging from 19 to 39.

3.4 Hydraulic Conductivity Testing

As discussed in the Section 2.0, bulk samples of the predominant soil types were obtained for hydraulic conductivity testing. The 9 samples were compacted to approximately 95 percent Standard Proctor density at approximately two percent above optimum moisture content. The test results indicate hydraulic conductivities for the relatively high plasticity soils ranging from 1.5E-05 cm/sec to 1.1E-08 cm/sec with six out of seven samples falling below 1.0E-5 cm/sec. The two cohesionless samples tested have hydraulic conductivities of 1.1E-5 cm/sec and 1.6E-5 cm/sec.

4.0 ANALYSIS AND RECOMMENDATIONS

The cohesionless soils (ML and SM) could pass the requirements for use as a soil liner or infiltration layer with additional laboratory analyses and properly controlled construction practices. These cohesionless soils would perform poorly as a closure soil or as a soil liner. The ML and SM soils would make a marginal structural fill. It is recommended that these soils be used for landfill operations such as daily and intermediate cover.

Generally, the soils having relatively high plasticity (MH and CH) should be used for liner and infiltration layers. These soils exhibit hydraulic conductivity values nearly an order of magnitude better than the required 1.0E-5 cm/sec.

The weathered granite is a relatively heavy and well graded soil that compacts, well as illustrated by the proctor graphs. This material is best suited for road construction.

5.0 ESTIMATED AVAILABLE QUANTITIES

Due to buffer requirements, the locations of streams and drainage features the potential borrow area is estimated at less that 30 acres. Using the approximate depth and thickness of the three predominant soils as classified visually and by laboratory methods, and the proposed extent of the borrow area, the following is a summary of the estimated quantities.

• Sandy silt (MH) and silty clay (CH)	150,000 cubic yards (CY)
• Silty sand (SM) and sandy silt (ML)	500,000 CY
• Weathered granite (SM) and rock	100,000 CY.
• Total quantity	750,000 CY.

The total quantity is based on excavation to 750 feet mean sea level along the existing borrow area with a one percent floor and 3:1 sideslopes.